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PUBLIC HEALTH REPORTS.

UNITED STATES.

[Reports to the Surgeon-General, Public Health and Marine-Hospital Service.]

THE PROPHYLACTIC VALUE OF VACCINATION.

[By Passed Asst. Surg. Henry S. Mathewson, Public Health and Marine-Hospital Service.]

Smallpox is supposed to have originated in Africa in prehistoric times. The first historical reference to the disease is an account of an epidemic of smallpox which developed in the Abyssinian army besieging Mecca in the year 571. From Mecca it spread over Asia and Europe. Procopius, in his history of the Eastern Empire, describes smallpox as present in epidemic form in Constantinople in 581, and Gregory of Tours records its presence in southern France in the same year. Throughout the middle ages references to smallpox are few and misleading, as it was much confused with measles and syphilis. The very name smallpox shows its confusion with and final differentiation from syphilis, or the pox, as syphilis was commonly called at that time. By the year 1600 smallpox had assumed epidemic form throughout Europe, and in the following two hundred years it continued its ravages unchecked, save by the exhaustion of the susceptible following years of great epidemics. Various mysterious causes have been assigned for the rise of certain infectious diseases to epidemic form at varying intervals, but the simple explanation suffices that in the interval a new generation is born and grows up and furnishes new fuel for the flame.

In England the disease was always present and but 1 person in 25 escaped an attack of smallpox. From 1761 to 1800 there died in the city of London an average of 2,037 persons yearly from smallpox.^a Its omnipresence is shown by the common proverbial saying "That few escape love and smallpox." It confined its assaults to no class, and royalty suffered equally with the peasant and the pauper, thus clearly indicating that differences in sanitary surroundings did not influence the incidence of the disease. It is estimated that in the one hundred years from 1700 to 1800 an average of 600,000 persons died yearly from smallpox throughout the world.^b Among preventive measures, prior to the discovery of vaccination, inoculation with the disease deserves a brief mention. Among the Turks it had long been practiced, and it was introduced into England in 1721 by Lady

^a Second Report Royal Vaccination Commission, 1890, p. 290.

^b Welch and Schamberg, p. 18.

Mary Wortley Montagu, who returned in that year from a period of residence in Constantinople. The advantages of inoculation were that one could by this means have the disease when young, when in good health, at a favorable time of the year, and often in a mild form. Many among the educated availed themselves of this practice, but it never became popular among the masses, as death not infrequently followed inoculation.

In the same year, 1721, Dr. Zabdiel Boylston, of Boston, introduced inoculation in America. During this year an epidemic of smallpox was present in Boston. Of Boylston's 286 inoculated cases, 6 died, a percentage of 2.09. During the same period, of 5,759 cases acquired by contagion, 844 died, a percentage of 14.6. During the colonial period smallpox was very prevalent, and scarcely a personal description is found in the prints or literature of the times that does not contain the terms "pockmarked" or "pock-fretten." To have had smallpox was a valuable recommendation in seeking employment, and this fact contributed to the establishment of inoculation hospitals in various parts of the country. Two were in operation near Boston in the year 1764, one of which contained 480 beds; others were established in the vicinity of New York and Philadelphia. There was much opposition to inoculation, and the practice ceased upon the discovery of vaccination.

Discovery of vaccination.—Prior to this discovery it had long been known that an attack of cowpox conferred immunity to smallpox. This fact has been observed by those engaged in dairying and the care of cattle in various parts of the world. In the dairy counties of England, among the Indian shepherds of Mexico, of Baluchistan, of India, and among the dairy population of Turkey smallpox had lost its terrors, but it remained for the acute mind of Edward Jenner to generalize from these isolated examples of immunity. He was living in Sodbury, England, when the chance remark of a dairy maid referring to smallpox then prevalent, "Oh! I can not take that disease, for I have had cowpox," called his attention to the subject. On May 14, 1796, he vaccinated his first case, James Phipps, aged 8 years, using serum taken from a cowpox vesicle on the hand of a dairy maid; on July 1 he proved the immunity of the boy to smallpox by his failure in repeated attempts to give him smallpox either by inoculation or exposure to the disease. The experiment was repeated many times in other subjects, and finally, in 1798, Jenner published an account of his work entitled "An Inquiry into the Causes and Effects of Variolæ Vaccinæ (Cowpox)." The discovery met with a storm of opposition and abuse.

The Parliament of England testified to the importance of Jenner's discovery by voting him £10,000 in 1802 and £20,000 in 1807. News of the discovery of vaccination spread rapidly to America, but the difficulty of conveying the vaccine virus without loss of potency delayed the first successful vaccination in the United States until July 8, 1800, when Dr. Benjamin Waterhouse, professor of medicine in Harvard College, successfully vaccinated his son Daniel, a boy of 5 years of age. Many successful vaccinations followed in Boston, and from these cases virus was conveyed to New York and Philadelphia. President Jefferson showed great interest in the discovery and lent the aid of his support to the new cause, the first vaccina-

tion in Washington being made on a member of his own family August 6, 1801. In 1802 he wrote to Doctor Waterhouse expressing recognition of the value of his work, and in 1806 he addressed the following letter to Doctor Jenner:

MONTICELLO, VA., May 14, 1806.

SIR: I have received a copy of the evidence at large respecting the discovery of the vaccine inoculation, which you have been pleased to send me and for which I return you many thanks. Having been among the early converts of this part of the globe to its efficacy, I took an early part in recommending it to my countrymen. I avail myself of this occasion to render you my portion of the tribute and gratitude due you from the whole human family. Medicine has never before produced any single improvement of such utility. * * * You have erased from the calendar of human afflictions one of its greatest. Yours is the comfortable reflection that mankind can never forget that you have lived; future nations will know by history only that the loathsome smallpox has existed and by you has been extirpated. Accept the most fervent wishes for your health and happiness, and assurance of the greatest respect and consideration.

THOMAS JEFFERSON.

Time has confirmed the soundness of the President's judgment as to the value of vaccination, but his prophecy as to the disappearance of smallpox still awaits fulfillment.

Vaccine virus.—For many years after the discovery of vaccination the arm to arm method was employed. This consisted, where possible, of the direct transference of the virus from the vesicle on the arm of one person to a small wound on the arm of another; or threads were wet in the fluid contained in the vesicle and dried and sent to a distance, where the threads were moistened and the material on them was used to vaccinate. This method of human arm to arm vaccination had its disadvantages and dangers. Syphilis was thus conveyed from person to person and care was not taken as to the contamination of the virus with pus-producing organisms.

A safer method of securing virus was soon sought, and Galbiati, an Italian physician, in 1811, first suggested that cowpox be artificially produced in calves and the virus obtained from these vesicles used for vaccination. This method was gradually adopted. Beginning with a spontaneous case of cowpox, calves are inoculated and thus a "strain" of virus is developed.

The process of vaccinating the calf is as follows:

The posterior half of its belly is shaved, cleansed, scarified in parallel lines, and inoculated with vaccine virus. The vesicles form in long, parallel lines; when mature, their content is removed under antiseptic precautions, mixed with glycerine and allowed to ripen for from 4 to 6 weeks. It is frequently tested for potency and freedom from contamination, and if it meets the Government requirements is prepared for market, either dried upon "ivory points" or put up in small glass tubes.

France and the United States are at present using a "strain" developed from a case of cowpox occurring in Beaugency, France, in 1871.

There is also in use with us a "strain" derived from a case of cowpox occurring in Cohasset, Mass., in 1881. The English official vaccine at present is derived from a case of cowpox occurring in England in 1881. These "strains" are maintained by transference from calf to calf. Cowpox is believed to be smallpox in a modified form and it is becoming a very rare disease. Should the present "strains" of

virus die out, it is possible to develop cowpox in the cow by inoculations with smallpox material from a human subject; otherwise the practical disappearance of cowpox would be a serious matter should the present "strains" of vaccine die out.

At present the production of vaccine virus in the United States is under Government control. The laboratories where it is produced are frequently inspected and their products are tested for strength and freedom from infection by the Hygienic Laboratory of the Public Health and Marine-Hospital Service, at Washington. Since this law went into effect a marked improvement in the character of the vaccine virus on the market has been observed. In cases vaccinated more good takes are obtained and fewer infected arms are seen.

In accordance with an additional regulation issued by the Secretary of the Treasury, March 13, 1906, each and every lot of vaccine virus must be examined bacteriologically by the manufacturer to determine its freedom from pathogenic micro-organisms, and a special examination is required of each and every lot to determine the absence of tetanus. Permanent records of these examinations are also required.

How and when to vaccinate.—Infants of any age may be vaccinated if smallpox is prevalent. If there is no danger of exposure to the disease, vaccination should be delayed until the child is from 4 to 6 months of age—in sickly babies it may be delayed until the child is 1 year old.

The best place to vaccinate a baby is on the outer side of the left leg, about 3 or 4 inches below the knee. All right-handed mothers and nurses carry the child upon their left arms. This brings the vaccination sore away from the body of the nurse and in little danger of being hit or rubbed. The leg is to be chosen rather than the arm when vaccinating children, as the abundant lymphatics of the groin better control the inflammatory reaction following vaccination than the relatively fewer lymph nodes in the axilla. In female children the leg should also be chosen, as scars upon the arm are often unsightly. In right-handed male adults the left arm is the site usually chosen for vaccination, at a spot on the outer side of the arm, 5 or 6 inches below the top of the shoulder.

The place chosen for vaccination should be well scrubbed with sterile soap and water, a soft sterilized brush being used. After scrubbing, wash off with alcohol and allow skin to dry. A fine cambric needle mounted in a short wooden handle or a small cork is the best scarifier. The point of the needle is sterilized by passing it through the flame of an alcohol lamp. The spot upon the arm or leg selected should be cross scratched over a surface about half the size of a dime. No blood should be drawn. It is sufficient if a small amount of serum appears. Upon this surface is spread the contents of one tube of glycerinated vaccine virus, which should be allowed to dry in before any dressing is applied. Then apply a shield or a simple dressing of sterile gauze held in place by 2 narrow strips of zinc oxide adhesive plaster.

After care.—This first dressing, if not soiled, need not be removed until the "take" occurs, on the third or fourth day. The skin around the "take" is generally reddened and inflamed and burns and itches. This should be smeared over with an ointment of zinc oxide and a sterile dressing reapplied. If signs of infection of the "take" ap-

pear, a wet dressing of warm 1-2,000 bichloride of mercury solution, frequently changed, should be applied. Great care must be taken to avoid infection of the vaccination wound, and protective dressings should be used until healing takes place.

What is a good take?—It is hard to verbally describe a good take. The physician doing the vaccination should see and pronounce upon each case.

What is a good scar?—"A perfect scar is round or oval, below the level of the skin about it, with well-defined margins, pitted or reticulated, and looks as though it had been stamped into the skin. Large flat scars are not signs of a good take, but of infection of the vaccination wound; large pits about the edges of a scar are a good sign of a take; the smaller pits scattered over the surface of a large flat scar are generally the dilated mouths of hair follicles and sebaceous glands."^a

Revaccination.—A vaccinated person is protected from smallpox in all cases for a period of six or seven years, in many cases for a far longer time. Children should be revaccinated at the age of 10 or 12 years. The compulsory vaccination law of the German Empire requires vaccination of every child before the end of the year following the year of its birth and revaccination during the twelfth year. After a second successful take revaccination is not necessary, unless in time of epidemic of smallpox or in those directly exposed to the disease, when revaccination from time to time is a wise precaution against infection.

OPPOSITION TO VACCINATION.

Opposition to vaccination rests on 5 fundamental declarations:

1. It is dangerous. 2. It is useless. 3. It is an invasion of the right of the individual. 4. Doctors favor it for the fee for vaccinating. 5. All statistics about smallpox are false.

1. *The dangers of vaccination.*—The dangers of vaccination exist at present chiefly in the minds of the opponents of vaccination. The chief source of danger remaining is an accidental infection of the wound caused by the vaccination. In this a vaccination wound but shares in the danger to any wound of infection. This in vaccination wounds amounts to 1 case of infection with fatal results in 65,000 vaccinations. Voight^b reports 2,275,000 vaccinations in Germany, with a total of 35 deaths. Recently he reports a series of 100,000 vaccinations with but 1 death. Hodgetts reports 40,000 vaccinations done in the Province of Ontario, Canada, without a death. Therefore, while we do not deny that there remains some danger to life in vaccination, we claim that with the exercise of due care it may be reduced to a point where vaccination is far less dangerous than the extraction of a tooth or the taking of an anæsthetic.

2. *It is useless.*—This statement is based largely on the fact that vaccinated persons do have smallpox. That we do not deny. The protection of vaccination becomes exhausted, and the disease is contracted, or a person is exposed to smallpox, is vaccinated, and has the disease in spite of the vaccination. In Prussia, between the years 1847 and 1873, vaccination was voluntary, and only a small part of

^a Adapted from Welch and Schamberg.

^b Voight. History of smallpox and vaccination (1901).

the population was vaccinated, and during these years there died of smallpox an average of 42.1 persons per year per each 100,000 of the population. In 1873 a compulsory vaccination law was passed and enforced, and from 1874 to 1901 there died of smallpox a yearly average of 1.3 persons per each 100,000 of population. Roughly estimated, deaths from smallpox were 40 times more frequent before than after vaccination became compulsory. The claim that improved sanitation has reduced the death rate from smallpox can not be proved. Austria is practically as far advanced in sanitation as Prussia, but has no compulsory vaccination law, and smallpox is widely prevalent and as fatal as ever. There has never occurred a case of smallpox in a person recently vaccinated successfully. The attendants at smallpox hospitals are vaccinated and revaccinated from time to time, and smallpox is unknown among those so protected.

At the Highgate Hospital, near London, where hundreds of smallpox cases are treated, but one attendant in the past sixty years, has taken smallpox, and that attendant was a gardener who was not vaccinated because he did not come in contact with the patients. In Boston during the 1900-1903 epidemic of smallpox no attendant at the various smallpox hospitals took the disease. Facts as to reduction of the death rate and immunity to the disease might be multiplied indefinitely, but enough has been said to prove that vaccination does protect. Even in those contracting smallpox years after having been vaccinated a certain factor remains which modifies the virulence of the disease and makes the death rate far lower than in the unvaccinated. The mortality among the vaccinated is as 1 to 7 among the unvaccinated, as shown by the following table from Reports of British Royal Vaccination Commission:

	Cases.	Deaths.	Per cent.
Vaccinated.....	8,744	461	5.0
Unvaccinated.....	2,321	822	35.1

3. *It is an invasion of the right of the individual.*—There is no answer to this argument if its premise be granted that the individual has a right to do as he pleases. This may be granted if the individual lives alone and comes in contact with no other human being. Life in communities invades and restricts the right of the savage, and community life is impossible on any other terms. The police power of a community rests on either the public- nuisance or the public-welfare ideas in common law and constitutional law; i. e., an individual may not maintain a public nuisance and group of individuals may act together for the public welfare. Therefore we find to-day the savage rights of the individual lessened in number and invaded on every hand. Compulsory vaccination laws, where they exist, have been upheld unanimously by all courts of appeal before which they have been tested, and the right of the community to enforce vaccination for the public welfare has been established. The individual who in exercising his right to do as he pleases contracts smallpox is conveyed to a pesthouse as a public nuisance, and his family are quarantined and vaccinated for the public good.

4. *Doctors favor it for the fee they get for vaccination.*—This trifling argument may be answered by the statement that vaccination is performed free of charge by Government officials, and the cost thereof is borne by the city or State wherever vaccination is compulsory.

5. *All smallpox statistics are false.*—Whether or not records are kept, smallpox does exist and kills or scars its victims and the fact of its existence and its danger remains, even if the disease is disguised under the name of measles, chicken pox, Philippine itch, or any other designation.

CONCLUSION.

During the past five years smallpox in the United States has shown a steady and gratifying decrease. In 1902 there were reported 54,014 cases with 2,083 deaths; during 1906 there were reported 12,503 cases with 90 deaths. This decrease has doubtless been brought about by increased vigilance on the part of State and national authorities and the wide dissemination of information in regard to the prevention of the disease. Many cities and States have enacted ordinances requiring the vaccination of all children before they are allowed to attend the public schools. In Germany, where vaccination is compulsory and universal, during the year 1906 there were, according to reports received by the Public Health and Marine-Hospital Service, in the whole Empire but 26 cases of smallpox with 5 deaths,^a and these cases were largely imported from neighboring countries, where smallpox is prevalent and unchecked by general vaccination. The experience of Germany, where compulsory vaccination has been in force for thirty years, proves conclusively that smallpox as existing in the United States is entirely unnecessary, and vaccination and revaccination can not be too strongly urged as the only means of removing this pest from our midst.

Reports from San Francisco, Cal.—Status of plague—Plague-prevention work.

Passed Assistant Surgeon Blue reports for the week ended January 18:

SAN FRANCISCO, CAL.

Sick inspected	47
Dead inspected	78
Necropsies held	2
Premises inspected	7, 015
Houses disinfected	87
Houses destroyed	16
Buildings condemned	11
Nuisances abated	701
Rats found dead	268
Rats trapped	4, 022
Rats identified:	
<i>Mus decumanus</i>	2, 154
<i>Mus rattus</i>	66
<i>Mus musculus</i>	139
Total	2, 359

^a See Public Health Reports June 29, 1906, December 28, 1906.